valve seat surfaces, a first valve seat surface which is engageable by a first end of the tubular sleeve and a second valve seat surface which is engageable by a second end of the tubular sleeve;

the third fluid conduit opens on to the valve chamber by way of a port which is surrounded by the first valve seat surface; and

when the first end of the tubular sleeve engages the first valve seat surface then fluid flows through the tubular passage in the sleeve from the third fluid conduit to the second fluid conduit and when the second end of the tubular sleeve engages the second valve seat surface then fluid flows through a gap between the first end of the tubular sleeve and the first valve seat to the third fluid conduit from the first fluid conduit wherein:

a spring means biases the sleeve into engagement with the first valve seat surface;

characterised in that:

the spring means acts directly on the sleeve.

The present invention in a second aspect provides a control valve for controlling flow of hydraulic fluid, the control valve comprising:

a valve housing;

a sleeve slidable in a valve chamber in the valve housing;

a first fluid conduit for connecting the valve chamber to a source of pressurised hydraulic fluid;

a second fluid conduit for connecting the valve chamber to a fluid return for returning hydraulic fluid to a reservoir;

a third fluid conduit for connecting the valve chamber to deliver hydraulic fluid to and receive hydraulic fluid from apparatus which uses the

hydraulic fluid flow controlled by the control valve, wherein:

the sleeve is a tubular sleeve having a tubular passage therethrough;

the valve housing has a pair of spaced apart valve seat surfaces, a first valve seat surface which is engageable by a first end of the tubular sleeve and a second valve seat surface which is engageable by a second end of the tubular sleeve;

the third fluid conduit opens on to the valve chamber by way of a port which is surrounded by the first valve seat surface; and

when the first end of the tubular sleeve valve engages the first valve seat surface then fluid flows through the tubular passage in the sleeve to the third fluid conduit from the first conduit and when the second end of the tubular sleeve engages the second valve seat surface then fluid flows through a gap between the first end of the tubular sleeve valve and the first valve seat from the third fluid conduit to the second fluid conduit; wherein:

a spring means biases the sleeve into engagement with the first valve seat surface;

characterised in that:

the spring means acts directly on the sleeve.

Both aspects of the invention share a common inventive feature that a sleeve is used to seal against two different end surfaces of the valve. In US-A-5064166 the tubular sleeve valve seals against only one end surface. The present invention provides a valve which has a connection to both a pressure line and a return line and which can control flow of fluid from the pressure line through the valve or flow through the valve back to a return line.

CLAIMS

1. A control valve for controlling flow of hydraulic fluid, the control valve comprising:

a valve housing;

a sleeve slidable in a valve chamber in the valve housing;

a first fluid conduit for connecting the valve chamber to a source of pressurised hydraulic fluid;

a second fluid conduit for connecting the valve chamber to a fluid return for returning hydraulic fluid to a reservoir;

a third fluid conduit for connecting the valve chamber to deliver hydraulic fluid to and receive hydraulic fluid from apparatus which uses the hydraulic fluid flow controlled by the control valve, wherein:

the sleeve is a tubular sleeve having a tubular passage therethrough;

the valve housing has a pair of spaced apart valve seat surfaces, a first valve seat surface which is engageable by a first end of the tubular sleeve and a second valve seat surface which is engageable by a second end of the tubular sleeve;

the third fluid conduit opens on to the valve chamber by way of a port which is surrounded by the first valve seat surface; and

when the first end of the tubular sleeve engages the first valve seat surface then fluid flows through the tubular passage in the sleeve from the third fluid conduit to the second fluid conduit and when the second end of the tubular sleeve engages the second valve seat surface then fluid flows through a gap between the first end of the tubular sleeve and the first valve seat to the third fluid conduit from the first fluid conduit; wherein:

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a spring means biases the sleeve into engagement with the first valve seat surface;

characterised in that:

the spring means acts directly on the sleeve.

2. A control valve for controlling flow of hydraulic fluid, the control valve comprising:

a valve housing;

a sleeve slidable in a valve chamber in the valve housing;

a first fluid conduit for connecting the valve chamber to a source of pressurised hydraulic fluid;

a second fluid conduit for connecting the valve chamber to a fluid return for returning hydraulic fluid to a reservoir;

a third fluid conduit for connecting the valve chamber to deliver hydraulic fluid to and receive hydraulic fluid from apparatus which uses the hydraulic fluid flow controlled by the control valve, wherein:

the sleeve is a tubular sleeve having a tubular passage therethrough;

the valve housing has a pair of spaced apart valve seat surfaces, a first valve seat surface which is engageable by a first end of the tubular sleeve and a second valve seat surface which is engageable by a second end of the tubular sleeve;

the third fluid conduit opens on to the valve chamber by way of a port which is surrounded by the first valve seat surface; and

when the first end of the tubular sleeve valve engages the first valve seat surface then fluid flows through the tubular passage in the sleeve to the third fluid conduit from the first conduit and when the second end of the tubular sleeve engages the second valve seat surface then fluid flows through a gap between the first end of the tubular sleeve and the first valve seat from the third fluid conduit to the second fluid conduit; wherein:

a spring means biases the sleeve into engagement with the first valve seat surface;

characterised in that:

the spring means acts directly on the sleeve.

3. A control valve as claimed in claim 1 or claim 2 wherein the tubular sleeve is connected by a rod to an armature located outside the valve chamber, the armature being located within an electrical coil also located outside the valve chamber.

4. A control valve as claimed in claim 3 wherein the spring means comprises a sprig which acts between a spring seat provided in the valve housing and a spring seat fixed to the exterior of the sleeve.

5. A control valve as claimed in claim 3 wherein the spring means applies a preload on the sleeve which must be overcome by a magnetic force applied to the armature by a magnetic field generated by the electrical coil before the sleeve moves away from the first valve seat surface.

6. A control valve as claimed in any one of the preceding claims wherein a compliant seal is provided to act between the exterior of the tubular sleeve and facing surface of the valve housing in order to prevent fluid passing along the outside of the tubular sleeve between the first and second fluid conduits and wherein the compliant seal deforms when the sleeve slides in the valve chamber so as to reduce or prevent sliding contact between the sleeve and the compliant seal.

7. A control valve as claimed in any one of the preceding claims wherein the first fluid conduit opens on to the valve chamber by way of a gallery which surrounds the first end of the tubular sleeve valve.

8. A control valve as claimed in any one of the preceding claims wherein the second fluid conduit opens on to the valve chamber by way of a gallery which surrounds the second end of the tubular sleeve valve.

9. A control valve as claimed in any one of the preceding claims wherein the tubular sleeve valve has a tubular wall which tapers in thickness at both ends of the tubular sleeve valve.

10. A control valve system for controlling a hydraulic actuator which has a control valve as claimed in any one of the preceding claims, wherein the control valve is operated as a digital valve with rate of fluid flow through the control valve varied by controlling a timing of switching of the sleeve between engagement with the first and second valve seats.

11. A control valve substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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